REMARKS

Consideration of this application as amended prior to examination on the merits is respectfully requested.

Submitted herewith is an Information Disclosure Statement for consideration by the examiner.

Also submitted herewith is a listing as Appendix A which identifies other co-pending applications and previously issued patents owned by the assignee for consideration by the examiner with respect to the relatedness to the present application.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attachment is captioned **VERSION WITH MARKINGS TO SHOW CHANGES MADE.**

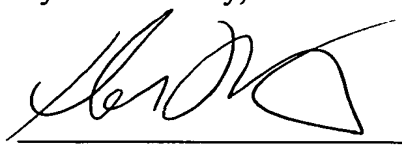
It is believed that this application now is in condition for allowance. Further and favorable action is requested.

The Office is authorized to charge or refund any fee deficiency or excess to Deposit Account No. 12-0755.

Respectfully submitted,

James Anthony Larkin et al

By their attorney,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

The Title of the Invention has been amended as follows:

METHOD AND APPARATUS FOR MOUNTING A BRAKE DISC WITH RESILIENT BIA[I]SING MEANS

Paragraph beginning at line 4 of page 1 has been amended as follows:

BACKGROUND OF THE INVENTION

1. Technical Field

This invention relates to a method and apparatus for mounting a brake disc in a disc brake. A particular application of the invention is to a spot-type automotive disc brake in which at least one, and preferably two brake discs are mounted for axial movement in use with respect to a central drive hub which drives the discs and on which they exert a braking effect during use. Typically, the central drive hub is a wheel mounting of an automobile. Certain aspects of the invention may find application outside the confines of spot-type automotive disc brakes.

2. Related Art

We have established that spot-type single or multi-disc disc brakes of the kind comprising axially mov[e]able discs can provide significant advantages over conventional spot-type automotive disc brakes. These advantages are set out in a series of patent applications which we have filed covering various aspects of the constructional differences between such brakes and conventional automotive disc brakes. –

Paragraph beginning at line 22 of page 1 has been amended as follows:

One aspect of these constructional differences relates to the use of resilient means acting between the one or more brake discs and the rotatable mounting therefor, such resilient means being provided to control certain aspects of the dynamics or movement of the

brake discs during use. Reference is made to the disclosure in WO 98/26192 [(docket 2558)] for a representative prior disclosure in this regard, and likewise too WO 98/25804 [(docket 2561)]. This latter disclosure concerns a disc brake system in which a plurality of leaf springs [(32,42)] mounted on a hub [(16)] and engaging the brake disc [(12)] apply radially-directed forces between the disc and the hub.

Paragraph beginning at line 16 of page 2 has been amended as follows:

Such an approach is consistent with the design principles emerging from the basic structure of the disc brake in which the relatively massive central hub provides a convenient reference base not only structurally for the mounting of the biasing springs, but also a relatively massive heat sink whereby a substantial thermal gradient exists in use between the brake disc with its locally-generated thermal energy and relatively low thermal capacity, whereby thermal factors favo[u]r minimi[s]zing the numbers of components to be subjected to frequent substantial thermal gradients, particularly components such as springs which are reliant upon thermally sensitive physical properties such as resilience.

Paragraph bridging pages 2 and 3, beginning at line 28 of page 2 and ending at line 5 of page 3 has been amended as follows:

SUMMARY OF THE INVENTION AND ADVANTAGES

However, we have discovered that despite the fact that the obviously apparent factors favo[u]r the adoption of the disc-mounting principles (with respect to resilient bias) disclosed in the prior art, there are significant and unexpected compensatory advantages in adopting the reverse approach wherein it is the disc itself which provides a mounting base for the resilient means (for example a series of circumferentially-spaced springs), whereby these can be considered as exerting a resilient bias which is directed from their mounting base on the disc to the rotatable disc-mounting hub, contrary to the teachings of the prior art.

Cancel lines 7 and 8 of page 3 in their entirety as follows:

[According to the invention there is provided a method and apparatus as defined in the accompanying claims.]

Paragraph beginning at line 10 of page 3 has been amended as follows:

In embodiments of the invention there are provided resilient means adapted to be mounted on the axially-slideable brake disc in various ways and in various formats providing individual variations in ease of construction and mounting.

Paragraph beginning at line 15 of page 3 has been amended as follows:

In one embodiment the individual resilient means straddle (either as a unitary construction or as to individual resilient elements) a series of projecting drive keys constructed to slideably cooperate with a series of complementary keyways formed in the rotatable mounting hub for the brake disc. This arrangement provides simplicity of achieving equi-spaced and likewise-balanced application of the resilient bias, without the need for cap screws or similar (potentially liable to corrosion) mounting means.

Paragraph beginning at line 11 of page 4 has been amended as follows:

A further practical advantage arising from the mounting of the resilient means on the brake disc or discs relates to the dynamics of the axially slideable mounting of the brake disc or discs with the respect to the drive hub or mounting means therefor. We have discovered that one result of the mounting of the resilient means on the hub itself in prior proposals is that appreciable variations in the spring force arise from disc movement itself and from the adoption of two or more discs mounted in face-to-face relationship on the same hub or mounting.

Paragraph beginning at line 27 of page 5 has been amended as follows:

In this regard, it is to be noted that the resilient means or springs used in the embodiments in relation to the friction elements for maintaining same in their normal [un]non-tilted attitudes, differ significantly from the springs disclosed in the above-identified WO 98/25804 and WO 98/26192 specifications in which the pad springs are mere anti-rattle springs not adapted to hold the brake pads against tilting movement, but merely to avoid rattling.

Paragraph beginning at line 1 of page 6 has been amended as follows:

Moreover, in the embodiments of the present invention the springs for the discs and for the pads are balanced in terms of their relative loading applied to the discs and the pads in order to achieve the necessary separation of same when braking is discontinued and yet holding the pads and discs against tilting during use. Thus, the spring forces exerted on the pads or friction elements of the present invention are much stronger than those needed merely to prevent rattling or noise suppression. The spring forces are sufficient to restrain the slideable brake pads or friction elements from moving into contact with the brake discs in an uncontrolled manner. The use of the substantially stronger pad springs in the present embodiments assists in positioning the outer rims of the brake discs in their brake-off position for reducing residual braking torque.

Paragraph beginning at line 16 of page 6 has been amended as follows:

[Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:]

THE DRAWINGS

These and other features and advantages of the present invention will become more readily appreciated when considered in connection with the following detailed description and appended drawings, wherein:

Figure 1 shows a diagrammatic representation of the thermal and related mass aspects and dynamic aspects of a spot-type disc brake having resilient means adapted to act between a relatively massive hub and a pair of axially slideable brake discs;

Paragraph beginning at line 4 of page 7 has been amended as follows:

Figures[s] 6, 7, 8 and 9 show a second embodiment of the invention in views corresponding somewhat to those of Figures 2 - 5 being a side elevation view of the assembly, a plan view of a leaf spring forming one of two resilient means, a side elevation view of same and an elevation view respectively;

Paragraph beginning at line 12 of page 7 has been amended as follows:

Figures 10, 11, 12 and 13 show related views of a third embodiment of the invention, showing the assembly, and three views of a wire-format spring forming resilient means therefor which is adapted to be mounted on the brake disc by co[-]operation of a wire end formation with a corresponding structure of the disc;

Paragraph beginning at line 11 of page 8 has been amended as follows:

DETAILED DESCRIPTION

In Figure 1 the thermal and related mass aspects, which will be referred to and described more fully below, are indicated by references A - E in which:

A refers to the Thermal Differential;

B refers to the Relatively Massive Hub;

C refers to the Spring Effect;

D refers to the Uniform Control of Dynamics; and

E refers to the Locali[s]zed Spot-Type B[b]rake E[e]ffect.

Paragraph beginning at line 21 of page 8 has been amended as follows:

As shown in Figure 1 a spot-type automotive disc brake system 10 comprises rotatable brake discs 12,14, a rotatable mounting or hub 15 for the discs 12,14 to permit such rotation and which is adapted to drive the brake discs and to have exerted thereon a braking effect by the brake discs when disc brake 10 is actuated.

Paragraph beginning at line 28 of page 8 has been amended as follows:

Two pairs of friction elements indicated at 16,18 and 20,22 are adapted to frictionally engage braking surfaces on opposite sides of brake discs 12,14 to effect braking on actuation of actuation means 24 therefor. Brake discs 12,14 are axially slideable in use with respect to mounting hub 15 therefor under the action of friction elements 16,18 and 20,22 and actuation means 24 during braking.

Paragraph beginning at line 1 of page 9 has been amended as follows:

Resilient device or means 26 is provided at circumferentially-spaced positions around brake discs 12,14 and is adapted to act between the brake discs and mounting therefor at said positions. The mounting of the resilient means 26 with respect to the brake disc 12, and on same, is such that the resilient means slides axially with the disc.

Paragraph beginning at line 8 of page 9 has been amended as follows:

Also shown in Figure 1 at 28 is an indication of the thermal differential which exists between rotatable mounting or hub 15, which has a relatively massive construction, and the brake discs 12,14 at which actuation means 24 causes a locali[s]zed spot-type braking effect.

Paragraph bridging pages 9 and 10, beginning at line 25 of page 9 and ending at line 1 of page 10 has been amended as follows:

Turning now to the embodiments of Figures 2 - 27, these will be described with reference to the general structure shown in Figure 1 in which the rotatable mounting or

hub 15 and one of the axially slideable brake discs 12 is shown in each of the seven embodiments as part of an assembly which may comprise one, two or more discs and an associated hub, as shown diagrammatically in Figure 1. It is to be understood that the purely diagrammatic representation shown in Figure 1 is intended to be simply a convenient reference base for the technically competent person, for purposes of description, detailed structures being shown in the remaining figures.

Paragraph beginning at line 3 of page 10 has been amended as follows:

In the embodiments of Figures 2 - 27, the resilient means which is provided at circumferentially-spaced positions around the brake discs and which is adapted to act between the brake disc 12 and the mounting for the brake disc 12 at those positions itself comprises mounting means for the resilient means (in the form of a spring or springs) which is adapted to mount the resilient means at these circumferentially-spaced positions on the brake disc or discs, so that when the resilient means is so mounted it applies a resilient bias directed from the mounting of the resilient means on the disc to the rotatable mounting or hub on which the disc is mounted. The resilient bias, or force acting between the disc 12 and hub is provided and generated by virtue of the resilience of the resilient means and deformation or bending of the resilient means. As will be understood by the person skilled in the art, deformation or bending of resilient means induces stress, for example torsional stress in the case where the resilient means are twisted, this induced stress in the resilient means generating forces acting in the opposite direction to the deformation or bending and tending to counter the deformation or bending. –

Paragraph beginning at line 1 of page 14 has been amended as follows:

In the embodiment of Figures 28 - 30 the disc 12 has keys 132 which engage in keyways in the hub 15. The resilient means comprises a strip of spring steel 130. The strip

130 in its uninstalled, unloaded condition is generally linear as shown in Figures 28 - 30. The strip includes a number of apertures 140 within it and at each end 136,138 there are recesses or notches 135. In the installed loaded condition of the strip 130 it is bent and mounted within the disc 12 with the apertures 140 fitting over and straddling the keys 132 of the disc. The end of the strip 130 abut against one 132A of the keys 132 with the notches 135,137 engaging on either side of that key. The three apertures [130] 140 are equally spaced so as to receive the three other keys 132 of disc 12 and the portions of strip 130 therebetween extend in use, in a generally chordal direction relative to the disc inner periphery and provide the resilient effect acting between the disc 12 and the hub 15 (not shown) which is mounted within the disc. It will be appreciated that the outer periphery of hub 15 abuts against the portions 131 of strip 130 between apertures 140.

Claims 1-10 has been canceled.

Add new claims 11-21.

ABSTRACT

A disc brake system of the kind comprising an axially fixed hub and at least one slideable brake disc comprises a resilient device acting between the disc and the hub to control certain aspects of the movement of the brake disc during use. Despite the thermal differential arising in use between the brake disc and the central hub due to the localized heat generation of the brake system and the mass and thermal capacity differences between the hub and the brake disc, whereby the hub would be expected to provide a more satisfactory mounting, the resilient device acting between the disc and the hub to control the disc dynamics is mounted on the disc. Such provides independence of the resilient bias with respect to disc position and disc relationship to another disc and with respect to simplicity of mounting and avoidance of dirt entrapment.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

ABSTRACT

A disc brake system [(10)] of the kind comprising an axially fixed hub [(15)] and at least one slideable brake disc [(12,14)] comprises a resilient device [means (26)] acting between the disc [(12,14)] and the hub [(15)] to control certain aspects of the movement of the brake disc [(12,14)] during use. Despite the thermal differential [(A)] arising in use between the brake disc [(12,14)] and the central hub [(15)] due to the locali[s]zed heat generation [(E)] of the [spot-type automotive] brake system [(10)] and the mass and thermal capacity differences between the hub [(15)] and the brake disc [(12,14)], whereby the hub would be expected to provide a more satisfactory mounting, the resilient device [means (26)] acting between the disc [(12,14)] and the hub to control the disc dynamics is mounted on the disc [(12,14), this leading to advantages in terms of] . Such provides independence of the resilient bias with respect to disc position and disc [(12,14)] relationship to another disc [(if present)] and with respect to simplicity of mounting and avoidance of dirt entrapment.

APPENDIX A

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